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AVIATION

AND AERONAUTICAL ENGINEERING



General View of Paris Aeronautical Exposition

Photo International

VOLUME VII
Number 12

SPECIAL FEATURES

IMPRESSIONS OF THE CHICAGO AERONAUTICAL SHOW
THE AEROMARINE MODEL 40 FLYING BOAT
THE GOODYEAR TYPE A PONY BLIMP
ORENCO MILITARY AIRPLANES
SUPERCHARGERS AND SUPERCHARGING ENGINES

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AVIATION AND AERONAUTICAL ENGINEERING

VOL. VII, NO. 12

Member of the Audit Bureau of Circulations

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J. D. MURPHY

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January 11, 1920

No. 12

THAT the Middle West will ere long become the most important market for aircraft manufacturers in this country seems a foregone conclusion to anyone who has followed the spread of interest in aeronautical matters in that section. Hence the American released the aircraft industry from the war effort, land machines and seaplanes have been acquired by many sportsmen and businessmen of the Middle West who were quick to grasp the possibilities of aircraft for utilitarian and pleasure purposes. Some are flying machines for commuting between their country houses and business centers, others employ airplanes to supervise their extensive farms, still others fly for the mere exhilaration flight offers to the red-blooded sportsman. Of course, in addition to this civil aviation proper, a great deal of commercial flying is being done on a small scale, such as ferrying passengers across large rivers and lakes, joy riding, parcel carrying, etc.

Still commercial air transport on schedule, by the use of large comfortably fitted airplanes, such as has become a daily occurrence in Paris and London, has not as yet come into being in this country. It is not that we lack the proper machines, the Martin Transport, the Curtiss Eagle, the Lawson Airliner, all prove the contrary. What this country needs for building up a merchant air service—and this cannot be emphasized too strongly, not often enough—is a class of properly laid out and equipped airways. It stands to reason that, just as the merchant marine was untenable without harbors and lighthouses, and automobile traffic needs good roads, commercial aviation requires suitable landing stations where airplanes can find shelter, supplies and repair when needed.

The Army Air Service and the Air Mail Service have already done much good with their campaign to enlighten the country at large in respect to these all important needs of commercial aviation. The Army Air Service has in particular done pioneering work by utilizing last year at the Southeastern Aeronautical Congress its landing field policy. Municipalities were thus made cognizant of just what kind of ground establishments are required for safe aerial navigation; that if they conferred in the outfit of airways with the speediness of the Army, the latter would furnish them with steel hangars free of charge. This policy has had an excellent effect on progressive communities, for these promptly availed themselves of the offer.

However, only a small beginning has so far been made, for a truly enormous task awaits this country in the organization of airways. While the initiative in this field will probably come from the municipalities,

just as it did in the matter of marine harbors, it seems that the federal government should nevertheless take a stand as to the form of assistance it may be willing to render in such case, since commercial aviation represents a public utility of great potentiality.

This question is closely related to the great problem of how civil aviation is to be regulated in this country without it being stifled by too many government restrictions and yet be prevented from falling into a state of chaos, which would undoubtedly occur if every state is permitted to regulate air navigation individually. The inspection, registration and licensing of aircraft should be made a federal function, as should the licensing of pilots and navigators, and the drawing up of the rules of the air. In brief, one aerial law should be in force over the entire territory of the United States, for the radius of action of aircraft makes state control entirely impracticable.

Rank Titles for Air Officers

One of the many debate problems which confront the proposed creation of a single air service, and which often causes needless opposition on the part of persons otherwise more or less favorably inclined toward such a scheme, is the question of rank titles.

Most bills providing for a unified air service merely follow army practice in this respect. This has on one hand led to opposition from military men, who feel that to create so many junior generals and colonels would lessen the importance justly attributed to these ranks. On the other hand, most Navy officers, who would be taken over bodily by the operation of such a legislation, will have none of it, because they do not believe it proper for seaplanes and admirals to take the rank of colonel and general.

The Royal Air Force of England has solved this puzzling problem in a manner that may have a suggestion in it for the proponents of our air force bills. Instead of meaning army or navy rank titles, R. A. F. officers are given titles entirely distinct from those used by the land and sea forces, although of strictly corresponding rank. The rank titles of the R. A. F. are, from the top of the hierarchy down: Marshal of the Air, Air Chief Marshal, Air Vice Marshal, Air Commodore, Group Captain, Wing Commander, Squadron Leader, Flight Lieutenant, Flying Officer, Pilot Officer.

As these ranks correspond to those of the British navy and army, they take precedence accordingly, while the distinctive titles spare the unpopularity of former army and navy officers. This scheme seems therefore entirely commendable.

The Aeromarine Model 40 Flying Boat

By Paul G. Zimmerman



FIG. 1. AEROMARINE MODEL 40 FLYING BOAT, AEROMARINE 14-H ENGINE

The great saving ability of large multi-engine flying boats was demonstrated in a stupor world when the NC-4 winged its rapid way to Europe. This proved beyond doubt that aviation might meet their aircraft long distances and repair and refuel them from surface vessels. It was not, however, discouraging concerning the ability of small flying boats, two or three passenger airplanes with a single motor, such as are now beginning to be used commercially and for sport purposes.

A most exciting test of the touring qualities of the small type of modern ship was made recently by the Aeromarine Plane & Motor Co., of Keyport, N. J. This company dispatched its Aeromarine model 40 flying boat (see Fig. 1) from New York on a long distance tour down the coast to Key West, thence to Havana, and back to Keyport by the same route. No special stations for repair or overhauling were considered, but it was the intention of the company that the plane should make the trip under precisely the same conditions as would confront an amateur free making the trip for sport or business pleasure.

Besides the flying boat itself, two types of Aeromarine motor with tested out under service conditions. The 14-h, an eight cylinder, 60 hp. V motor was used on the Key West, and the 14-h, an eight cylinder, 60 hp. V motor was used on the Key West, and the 14-h, an eight cylinder, 60 hp. V motor was used on the Key West.



FIG. 2. AEROMARINE MODEL 40 FLYING BOAT, AEROMARINE 14-H ENGINE

While en route the plane used ordinary gasoline and oil from automobile or motor boat system, and on one occasion stopped at the coast near St. Augustine, Fla., borrowed a gallon of oil from an attendant motor boat crew, and went on with minor repairs enroute.

The plane was piloted by C. J. Zimmerman, chief test pilot for the Aeromarine company. He was accompanied by Harold Greenaway, mechanic. Also, a ball bag, also went along, and passed with more than his weight in gasoline as a matter of fact.

The trip began on Oct. 22 and ended on Nov. 3, 1929. A stop of more than two weeks was made at Key West for the purpose of changing letters and to investigate the first air law between Havana and Key West. The service was started by a Cuban-American company with Aeromarine flying boats.

There was an intention of establishing a record for the trip either in flying or elapsed time, for the primary design of the ship was exactly to reproduce normal aerial touring conditions. Originally had legs were necessary to avoid obstructions, and stop over was made because of this. The start from Keyport was delayed one hour because of fog, but as soon as it had lifted slightly Pilot Zimmerman hoped off and ascended in flying through the mist to Atlantic City, the first scheduled stopping point. There he was alone in the surface of the water to get his bearings.

Flying down the Atlantic coast would mean on first thought it was a very easy matter, but as a matter of fact, wind currents, fog, which often generated from marine, was necessary. A compass, rubber chart, with lighthouses, life-saving stations,



FIG. 3. CONSTRUCTION OF AEROMARINE BOAT HULL AT SHIPYARD

buoys and other landmarks plainly indicated, was used. The map was of the strip type. Whenever the carrying coast line tended to stray off the chart the land was straightened out in the map and a few navigational corners marked in the journey. The map was mounted in a canvas box with a ruler on each end. The front of the box was covered with sheet celluloid so that the map itself was screened from wind and water. The pilot could follow his course simply by turning up the side of the chart. The distance from the starting point of the various life saving stations was noted on the map so that the pilot could keep accurately advised of his location at every stage of the flight.

At the place carried gasoline for about three hours' flight, stops were made at distances of 100 mi. or less. The longest distance flown in a day was 216 mi., from Marion, N. C., to St. Augustine, Fla. Flying time was about 24 hr. and of this the return journey, which was hampered by bad

weather and unusually strong head winds, was made in 20 hr. in the air.

General Description

The boat which made the flight is a pusher type of aircraft, with the motor in the rear and the wings in the front. The design of the ship was particularly adapted to the general conditions of the coast, where the weather is usually calm and the water is shallow. The ship is built of steel, with the hull and wings made of steel plates. The ship is built of steel, with the hull and wings made of steel plates.



FIG. 4. CONSTRUCTION OF THE AEROMARINE MODEL 40

At the top a separate sheet steel engine bed holds the motor, which is bolted to cross braced steel beds, fixed top and bottom with web. The bed is made of these tubes project past the upper ends of the engine beds and from the attachment for the taking upper panel supports. Transversely the beds are braced in the planes of supports, fixed and rear by cross tubes attached at the top and bottom to the same bolts as the supports.

At the top a separate sheet steel engine bed holds the motor, which is bolted to cross braced steel beds, fixed top and bottom with web. The bed is made of these tubes project past the upper ends of the engine beds and from the attachment for the taking upper panel supports. Transversely the beds are braced in the planes of supports, fixed and rear by cross tubes attached at the top and bottom to the same bolts as the supports.

The motor is mounted directly to a pusher gaspiller. Clearance for the gaspiller is cut out of the upper panel, the panel edge being carefully smoothed in the panel.



FIG. 5. CONSTRUCTION OF THE AEROMARINE MODEL 40

Substituting in (3):

$$\frac{W}{A} \frac{dV}{dt} = \frac{W}{A} \frac{dV}{dt} \frac{1}{V} \frac{dV}{dt} = \frac{W}{A} \frac{dV}{dt} \frac{1}{V} \frac{dV}{dt} \quad (10)$$

and integrating:

$$\int \frac{W}{A} \frac{dV}{dt} \frac{1}{V} \frac{dV}{dt} = \int \frac{W}{A} \frac{dV}{dt} \frac{1}{V} \frac{dV}{dt} \quad (11)$$

or (12) $\frac{W}{A} \frac{dV}{dt} \frac{1}{V} \frac{dV}{dt} = \frac{W}{A} \frac{dV}{dt} \frac{1}{V} \frac{dV}{dt}$

Here as in (8), V represents V as a function of t , and then clearly



FIG. 1

To its effect, consider the typical spiral surface of the following characteristics:

$$\begin{aligned} A &= 45 \text{ deg. glide} \\ W &= 2000 \text{ lb.} \\ P &= 100 \text{ hp} \\ C &= 75 \text{ per cent.} \\ V_s &= 120 \text{ ft. per sec.} \end{aligned}$$

Here:

$$\begin{aligned} R_s &= 375 \text{ ft.} \\ \frac{W}{A} &= 0.25 \\ K &= 0.015 \\ T &= 274 \text{ ft. per sec. or 148 ft. p-h} \\ \frac{W}{A} &= 1000. \end{aligned}$$

It appears, then, that a dive of 1000 ft. at 45 deg. in the horizon will mean the machine to acquire a velocity nearly 70 per cent. in excess of the normal maximum speed. The time to acquire this excessive velocity will be less than 10 sec., if power is left on, and it should be noted at this point that in the calculations the acceleration due to propeller thrust in the initial stages has been neglected.

Velocity gains in excess of normal may be reached voluntarily by a pilot in free flying, or he can obtain it in a more definite following a stall, or other temporary loss of control, and it is of interest to examine into the structural strength of our machines under such abnormal conditions.

The typical airplane shows above four corners at an angle of incidence of 2 deg. The angle of incidence is about 4 deg. in the wing chord, and from this point the lift curve plotted as angle of incidence is practically a straight line.

In order to maintain a straight trajectory on a glide, the component of the weight normal to the direction of motion must equal the normal aerodynamic reaction of the wings. This reaction is horizontal lift is vertically upward and is called lift. For convenience, let us continue to call this reac-

tion, lift. The approximate law of the variation is, therefore,

$$L = C \frac{1}{2} \rho V^2 S \quad (13)$$

where C is a constant for a particular machine and arrangement of surfaces, and ρ the ratio from air to sea.

In one particular case $C = 0.5$ and $V_s = 120 \text{ ft./sec.}$ Then for $V = 190 \text{ ft./sec.}$

$$\frac{W}{A} \frac{dV}{dt} \frac{1}{V} \frac{dV}{dt} = \frac{W}{A} \frac{dV}{dt} \frac{1}{V} \frac{dV}{dt} \quad (14)$$

The airplane on the 45 deg. glide is flying at an angle of 1.4 deg. from the angle of an airfoil, or half the wing chord inclined — 2.8 deg. to the relative wind. The lift load on the wings is not excessive, but the resistance or drag load is nearly 2.5 times the amount in horizontal flight. The rear wing experiences less lift, but in compensation by the latter load, and at this angle the rear span is carrying practically the entire lift load. However, modern airplanes are usually able to support the load with safety.

The really dangerous machine commences immediately when the pilot turns up his elevator to pull out of the dive. It is usual to provide a control system giving such a continuous advantage that a strong sense of safety in the elevator hand up even when making excessive speed. Consider the pull on the control wheel to be 75 lb., which, in this particu-

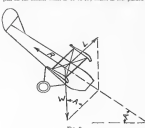


FIG. 2

lar case, would give a resulting moment of 1500 in. lb. about the hinge of the elevator. The pressure on the elevator would then be about 100 lb., which would give a moment of approximately 1700 in. lb. about the center of gravity of the machine. Assuming the radius of gyration of the whole plane as 5 ft., giving us a moment of inertia of mass of 1500 lb., the angular acceleration would then be:

$$\frac{d\omega}{dt} = \frac{M}{I} = \frac{1700}{5} = 340 \text{ rad/sec}^2 \quad (15)$$

It is evident from this large angular acceleration that the machine may be pulled out of a dive very quickly by cutting a pull of 75 lb. on the control lever. At a speed of 190 m.p.h. and an angle of incidence of 1.4 deg. the factors of safety of several of the structural members of the machine become unity. It does not seem reasonable that the change of angle should require more than 100 sec. and the machine ought to lose but a small amount of its velocity in so short a time.

Therefore C as to be expected that some structural member of the machine will fail.

The above calculation is based upon several assumptions, but such assumptions are considered plausible. The machine is evident that any airplane of great construction can be worked in the air by severe abuse.

The Variable Angle of Incidence Airplane

The problem of the variable angle of incidence machine may be considered from four points of view:

- (1) Aerodynamical efficiency
- (2) Longitudinal stability and controllability
- (3) Structural reliability
- (4) Landing possibilities

Aerodynamical Efficiency.—The resistance of a plane is divided into two parts, wing drag and parasite resistance. The parasite resistance forms a large percentage of the total resistance of the airplane, and the variable angle of incidence machine is an attempt to reduce it. The parasite resistance of a plane is approximately least when the fuselage is in the line of the wind. When the airplane flies at a higher angle, and the fuselage is at a greater angle to the wind, the parasite resistance increases accordingly. In the variable angle of incidence machine, the fuselage, struts, etc., are maintained in the

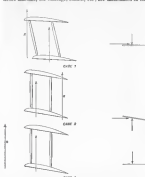


FIG. 3 CASES OF LONGITUDINAL STABILITY

line of the wind with a theoretical gain in efficiency. In practice it is very doubtful whether this theoretical gain in efficiency is realized.

To discuss the question, we can have consultation on investigation of various machines conducted at the Massachusetts Institute of Technology (Research Department Memorandum No. 31) and on report No. 18 (1917) of the National Advisory Committee on Aeronautics.

In these two reports a careful analysis of the resistance of the Curtiss JN-2 has been made. This machine has an angle of incidence of 2 deg. to the wing. If the machine is flown at 18 deg. the body of the Curtiss JN-2 is at 7 deg. to the wing. If we imagine the Curtiss JN-2 with variable angle of incidence there would be a saving equal to the difference between parasite resistance at 7 deg. and parasite resistance at 2 deg. But to balance the slight saving there, we must make allowance for the resistance of the mechanism which the variable angle of incidence machine necessitates.

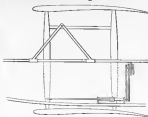


FIG. 4 DIAGRAM OF PLAN VIEW OF VARIABLE ANGLE OF INCIDENCE

The appearance of the Lusine was taken as a basis for these computations. Since this superstructure might be considerably improved, and since the JN-2, if not a smaller machine, has less stream in resistance, the parasite resistance of the Lusine has been reduced by 50 per cent. in applying to the Curtiss. The final resistance and horsepower figures show that there is finally a loss and not a gain in the variable angle of incidence machine, and this partly on grounds of resistance. The increased weight due to complexity of the mechanism would work still further against this type of airplane.

Longitudinal Stability and Controllability.—To study this thoroughly, a great deal of wind tunnel experimentation would be necessary, but the simple diagram in Fig. 3 indicates that the variable angle of incidence machine would have a tendency to stall at large angle of incidence and be very disconcerting to the pilot. At small angles, the tail would act as an ordinary machine, i.e., a non-lifting tail leading to prevent some hazards; this is indicated in Case 1.

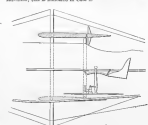


FIG. 5 DIAGRAM OF LANDING INCIDENTS CHANGE GEAR

Case 2 is that of an ordinary machine at a big angle of incidence where the tail is now a lifting tail, supporting stallings. In Case 3 we have the variable angle of incidence machine at a big angle. The tail is now lifting and sticking out of the water. Such a machine would therefore present very considerable difficulties in longitudinal stability and control.

Structural Adaptability.—In Figs. 2 and 3 are shown diagrammatically the mechanism of the Ford Reliance II and the Leavitt. These are self-explanatory. Without any close study, it is seen that these machines are complicated, add weight and severely add to the reliability of the plane.

Loading Possibilities.—An advantage sometimes claimed for the variable angle of incidence machine is that it can be loaded at low speed with horizontal loading. This is rather dubious since otherwise it is a land machine, where it is desirable to touch the wheels and tail skid to the ground at the same instant, but may be a great advantage in a water machine, where whatever the speed of flight, the machine can be "land down" as the water with the foot at its normal running position.

Conclusions.—Since there is no aerodynamic gain and possibly slight loss, complication, added weight and no compensating advantage, the future of the variable angle machine seems very doubtful. *Excerpt from a report of the Aeronautics Research Department, McCook Field.*

Handley-Page Type W.8

The Handley-Page W.8 transport airplane is the first post-war product of this firm. It is designed so as to provide a single large cabin 22 ft. long, 4 ft. 6 in. wide and 8 ft. high, which affords accommodation for from fifteen to twenty passengers. The space provided is entirely unobstructed by wires or cross struts, and when used for carrying cargo reliably, 475 cu. ft. of space is available. Pilot and engineer are in a well-shaded cockpit immediately forward of the cabin.

Four side windows, which can be opened or shut, are provided along each side of the passenger cabin, one for each occupant. In the floor, hatches are fitted in order to provide a direct route down to the ground.

The interior of the cabin is lavishly equipped with carpets, curtains, electric lights, lamps, clocks, mirrors, window appliances, cigarette, tea and coffee. Flower vases and velvet cushioned arm chairs with rectangular for seats, backs and corners give the machine the appearance of a comfortable Pullman car.

When carrying large consignments of cargo, light radio, electric and telephone can be fitted on either side of the cabin, leaving a central gangway. Large doors are fitted at the side of the machine and there is a trapdoor in the floor to facilitate the entry and removal of freight. A door also communicates between the passenger cabin and the pilot's cockpit.

The engine are provided with effective silencers to enable conversation to be carried on amongst the passengers.

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PERFORMANCE AND PERFORMANCE

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Engine (optional)	Two 1500
Engine (optional)	Two 1800
Engine (optional)	Two 2000
Engine (optional)	Two 2200
Engine (optional)	Two 2400
Engine (optional)	Two 2600
Engine (optional)	Two 2800
Engine (optional)	Two 3000



CLIQUE OF THE HANDLEY-PAGE W.8
Photo International

From fifteen to twenty passengers or 2 tons of freight can be carried. For shorter distances than 500 mi. the weight can be correspondingly increased.

IN SUMMARY

Single engine class	22 ft. long	13 ft. 6 in. wide	8 ft. high
Engine (optional)	4 ft. 6 in. wide		
Engine (optional)	8 ft. high		
Maximum load with wind added			
Total payload, including			
Wind and engine			



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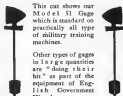
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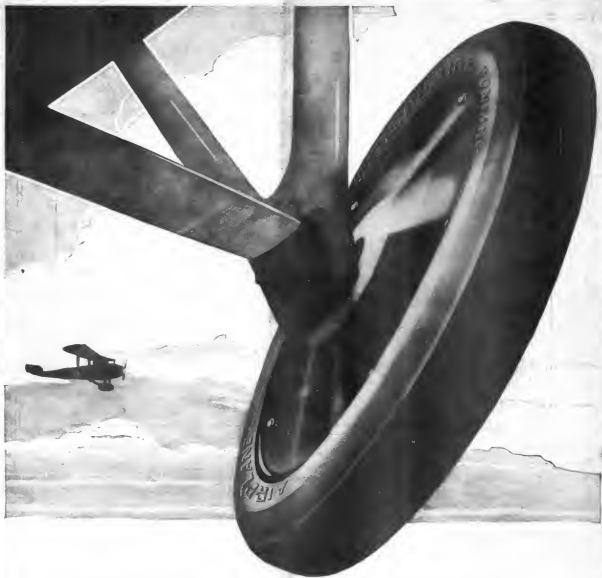
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